

A1
cont.

source coordinates to referenced geographic coordinates, which are typically in standard latitude/longitude. An image or a vector file is georeferenced to be used within a mapping/geographic environment. In a vector map, the data from which the map is drawn will typically already include a geographic coordinate set.

Please amend the second full paragraph on page 10 of the specification to read as follows:

A2

When four or more georeferencing point-pairs are determined, the general linear georeferencing functions are over-determined. This means that more than the required amount of information to compute the general linear georeferencing functions is available, but that it is not, in general, completely consistent. The system uses the extra information contained in the additional georeferencing points to provide validation checks to protect against the possibility that some of the data points may be inaccurate **(step 430)**. Points that deviate excessively with respect to a calculated standard error are presumed to be inaccurate and are omitted from the calculation of the georeferencing functions. Note that as new points are added, the system also rechecks points previously marked as inconsistent, to determine if those points should now be considered when recomputing the georeferencing functions.

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Please amend the first and second paragraphs on page 11 of the specification to read as follows:

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A3

The user may then proceed to enter the next point-pair (**step 440**). When the user is finished, the system stores the active georeferencing functions with the raster-map (**step 445**). At this time, the raster map is considered fully georeferenced. When accessed at any future time, the system may simply retrieve the georeferencing functions, and apply them to find the latitude and longitude of any point on the raster map.

The process of determining the georeferencing function set from a set of point-pairs is believed to be within the ability of one of ordinary skill in the art. The specific approach used by the system and method of the preferred embodiment is discussed below.

Please amend the fourth paragraph on page 11 of the specification to read as follows:

A4

Once determined, \hat{f} will be the georeferencing function which is used to compute corresponding latitude and longitude values (Lon, Lat) for any point (x, y) on the bitmap. There are any number of possible ways to define the function that "comes closest to making (1) true." We shall follow a "least squares" approach also known in mathematics as an L_2 approach. This approach seeks to find the function, \hat{f} , which minimizes the sum of the squared differences between the actual and the predicted values of latitude and longitude. In other words, from among all the functions $f \in F$, \hat{f} is the one which minimizes:

Please amend the first full paragraph on page 12 of the specification to read as follows:

A5 Among various alternative methods for choosing the function \hat{f} are choosing it so that it minimizes the sum of absolute errors (rather than squared errors), or so that it minimizes the largest error. Other criteria are also possible.

Please amend the last paragraph on page 13 of the specification to read as follows:

A6 These systems can be easily solved by well-known methods, such as Gaussian Elimination or LU factorization. The solutions yield the desired values of \hat{a}_{11} , \hat{a}_{12} , \hat{a}_{21} , \hat{a}_{22} , \hat{b}_1 , and \hat{b}_2 . It should be noted that equations (5a) and (5b) do not have a unique solution unless three or more non-colinear points are contained in A. Generally speaking, then, it requires 3 points to choose a georeferencing function from the family of general linear transformations. When there are four points or more, it is possible to compute a standard deviation of errors using the formula:

Please amend the first and second paragraphs on page 16 of the specification to read as follows:

A7 These systems can be easily solved by well-known methods, such as Gaussian Elimination, or LU factorization. The solutions yield the desired values of $\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$, and $\hat{\beta}_4$, which in turn yield the desired values for \hat{a}_{11} , \hat{a}_{12} , \hat{a}_{21} , \hat{a}_{22} , \hat{b}_1 , and \hat{b}_2 .

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A7
cont.

It should be noted that equation (8) does not have a unique solution unless two or more points are contained in A. Generally speaking, then it requires two points to determine a georeferencing function from the family of rotational linear transformations. When there are three points or more, it is possible to compute a standard deviation of error, s using the formula:

Please amend the second paragraph on page 17 of the specification to read as follows:

Automatic Error Detection and Handling

When individual points are being assigned x, y, Lon, and Lat values, there is always a potential for error. To reduce the risk of incorrect georeferencing resulting from such errors, certain error handling procedures are built into the georeferencing process. The fundamental concept is that of detecting a "bad" point and then removing it from the set of active points, A. Note that removing a bad point from A will not delete the information associated with that point, but it will cause the georeferencing parameters to be completely uninfluenced by that point. We do not wish to remove the point entirely, since it may be determined at a later stage of the georeferencing that the point was not really bad at all, and should be used in the georeferencing calculation. This will be clarified shortly.

A8

Please amend the second full paragraph on page 18 of the specification to read as follows:

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A9

There are several things to note about this procedure. One is that allowing the values of c_1 and c_2 to change with the number of active points, makes it possible for the georeferencing system and method to utilize points which it might originally determine bad or inconsistent after a large enough sample of points has been gathered to make it clear that a lesser level of accuracy is all that can be achieved on this map. Another observation is that by using this procedure it is impossible to reduce the number of active points down to less than four (unless you started with less than 4 in which case this procedure does not apply at all). This scheme means that as each new point is added, all points determined so far are considered, even those that had previously been marked bad. Thus early "misjudgments" on the part of the system can be corrected later, in light of new point information.

Please amend the last paragraph on page 19 of the specification to read as follows:

A10

A specific example of the operation and application of the preferred georeferencing method may be shown with reference to the "Flood Zone Determination" business. The Federal Emergency Management Agency (FEMA) publishes a library of tens of thousands of paper maps showing various types of flood zones and their locations in the United States. A flood zone determination on a property is frequently done in the following way:

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1. The address of the property is examined, and the location of the property is determined (perhaps through the use of a geocoding system, or by examining an available street map).
2. A map analyst attempts to determine which of the many thousands of FEMA flood maps will contain this property.
3. The map analyst goes to a map storage area and retrieves the desired map, often examining several maps before making a final selection.
4. Having retrieved the paper map, the map analyst next determines where, precisely, the property is located on the map.
5. Finally, the map analyst examines flood zone notations on the map at the property's location in order to determine its flood-zone status.

Please amend the last paragraph on page 20 of the specification to read as follows:

Using georeferenced flood map raster images, steps 2 and 4 above, are replaced by:

2. A computer system combines the pre-designated outlines of the raster map and the georeferencing information to obtain a polygon expressed in terms of latitude and longitude that

outlines the region included in each flood map. Then the system determines which of the polygons contain the address in question, which is done using a "point-in-polygon" algorithm. At the conclusion of this process, the computer system has identified a map panel (or perhaps a small number of map panels) that contains the address.

4. Since the latitude and longitude of the property are known (by virtue of a geocoding phase), the computer system can use the georeferencing of the map panels to locate the property on each of the panels found above, thus largely eliminating any need for the map analyst to scan the flood map for the address location.

IN THE CLAIMS:

Please cancel claims 7, 13, and 18.

Please amend claims 1-6, 9, 11, 12, 15-17, 19 and 20 as follows:

1. (Amended) A method of georeferencing a raster map, comprising:
 - displaying a first map in one area of a display, said first map being a digital raster map;
 - displaying a second map in a second area of the display, the second map being a georeferenced map that displays at least a portion of an identical geographic region displayed in the raster map;
 - selecting at least two points on the first map; and

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